



SURFACE VEHICLE STANDARD

J747™

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Superseding J747 NOV2017

(R) Control Valve Test Procedure

RATIONALE

Major revision to update reference standards, change verbiage in regards to pressure and flow rating, valve test criteria, and figures containing worksheets and data plots.

SAE J747 has been reaffirmed to comply with the SAE Five-Year Review policy.

FOREWORD

In the selection and application of hydraulic directional control valves, it is necessary to know their operating characteristics. This SAE Recommended Practice provides the test and reporting procedure to obtain flow versus pressure drop, leakage rate, operating effort, metering pressure or flow versus spool travel and relief valve characteristics at fluid temperatures of 50 °C (122 °F) and 90 °C (194 °F).

1. SCOPE

This SAE Standard applies to hydraulic directional control valves as applied to self-propelled work machines referenced in SAE J1116. It describes a laboratory test procedure for evaluating:

- a. Flow versus pressure drop
- b. Leakage rate
- c. Operating effort
- d. Metering characteristics versus spool travel, pilot pressure, or electrical current
- e. Relief valve characteristics

The document applies to single and multiple section hydraulic directional control valves.

This document illustrates axial, manually operated valves although the test procedure is applicable to other input forms such as rotary actuation, electric current, hydraulic or pneumatic pressure.

Performance characteristics such as metering hysteresis or dynamic response may have a significant effect on some of these tests.

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Documents

Document Sharing Hub

1.1 Purpose

To provide a uniform procedure for measuring and reporting the operating characteristics of a hydraulic directional control valve and associated relief valve when so equipped.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated the latest revision of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE TSB 003 Rules for SAE Use of SI (Metric) Units

SAE J1116 Categories of Off-Road self-Propelled Work Machines

SAE J1117 Method of Measuring and Reporting the Pressure Differential-Flow Characteristics of a Hydraulic Fluid Power Valve

SAE J1235 Measuring and Reporting the Internal Leakage of a Hydraulic Fluid Power Valve

SAE J1276 Standardized Fluid for Hydraulic Component Tests

2.1.2 ISO Publications

Copies of these documents are available online at <http://webstore.ansi.org/>.

ISO 4406 Hydraulic Fluid Power – Fluids – Method for coding the level of contamination by solid particles

ISO 6743-4 Lubricants, Industrial oils and Related Products (class L) - Classification – Part 4: Family H (Hydraulic systems)

ISO 3448 Industrial Liquid Lubricants – ISO Viscosity Classification Second Edition

ISO 1219-1 Fluid power systems and components -- Graphic symbols and circuit diagrams -- Part 1: Graphic symbols for conventional use and data-processing applications

ISO 5598 Fluid power systems and components – Vocabulary

3. DEFINITIONS

3.1 RATED FLOW

Maximum design flow for valve inlet port, work ports, and return ports.

3.2 RATED PRESSURE

Maximum continuous design pressure for the valve inlet port, and peak design pressure for the workports.

3.3 PORT IDENTIFICATION

Work port "A" is the port farthest from the spool spring centering mechanism. Work port "B" is closest to the centering mechanism. The No. 1 circuit is the valve section located nearest the valve inlet port. "P" is the main flow inlet port. "T" is the main return flow outlet port. For special circumstances submit a sketch of all ports.

3.4 TEST PRESSURE

Valve test pressure agreed upon by user and supplier.

3.5 TEST FLOW

Valve test flow agreed upon by user and supplier.

3.6 DESIGNATED LOAD INTERFERENCE PRESSURE

Pressure difference between the "P" port and the "A" or "B" work port, which may be elevated when the same pump is providing flow to multiple functions, and one function is requiring a higher actuation pressure than another.

3.7 PRESSURE DROP

Pressure difference between any two measurement locations.

3.8 LEAKAGE RATE

Volume of oil per unit time that leaks past a blocked passage at a given pressure differential and oil viscosity.

3.9 OPERATING EFFORT

Maximum effort necessary to shift the spool from its hold or neutral position to its shifted position and the effort exerted by the spool or required to move the spool from each shifted position back to neutral.

3.10 METERING CHARACTERISTICS

Circuit output (pressure or flow) as it relates to a control input (spool stroke, pilot pressure, or electrical command current).

3.11 MAIN RELIEF

A relief valve which limits the inlet pressure of the valve (may or may not be integral to the valve).

4. GRAPHIC SYMBOLS

Graphic symbols used herein are in accordance with ISO R 1219- and ANSI Y14.17-. Where ISO R 1219- and ANSI Y14.17- are not in agreement, ISO R 1219- governs.

5. UNITS

5.1 The International System of Units (SI) is used herein in accordance with SAE TSB 003.

5.2 Approximate conversion to "U.S. customary" units appear in parenthesis after SI units.

6. SUMMARY OF DESIGNATED INFORMATION

6.1 Specify a full description of the valve, including all functions and features, on all requests for this test. For an example of descriptive data that may be documented (see Figure 1).

6.1.1 The number of total sections (if sectional valve), and/or total number of spools.

6.1.2 The rated flow and rated pressure

6.1.3 The port type (O-ring, flange, flare, etc.), size, and orientation or placement on the valve section.

6.1.4 The control input range (stroke, pilot pressure, current, etc.)

6.1.5 The location, type and setting of all relief valves (circuit, LS, etc.)

6.2 Specify a full description of the test fluid used (see Section 15):

6.2.1 The type of fluid.

6.2.2 The fluid test temperature.

6.2.3 The fluid cleanliness level.

7. GENERAL PROCEDURE

7.1 Conduct the test for entire control input range.

7.2 When referring to this specification for catalog information and sales literature, use only standardized values shown in Section 15.

7.3 Test and report of subplate mounted valves may run with the subplate included. Reports shall explicitly indicate how such valves were tested.

7.4 To minimize variables, the valve temperature shall be stabilized within 3 °C (5 °F) of the temperature of the fluid and actuate the valve spool or relief at least twice before taking respective data. For close coordination between testing laboratories, similar equipment, fluid and procedures are recommended.

8. THE CONDITION ACCURACY OF UNITS

Maintain the test condition accuracy within the limits shown in Table 1:

Table 1

Test Condition	Maintain Within $\pm$	SI Unit	US Unit
Flow	2%	L/min	gpm
Pressure	2%	kPa	psi
Pressure Differential	2%	kPa	psi
Temperature	1 °C (3.5 °F)	°C	°F
Force	2%	N	lbf
Torque	2%	N.m	lbf.in
Spool Position (or Control Input) ¹	2%	mm	in
Time	0.5%	min or s	min or s

Percentages are of maximum reading.

8.1 Precautions shall be taken to obtain readings unaffected by turbulence and velocity.

8.2 Back pressure shall be 700 kPa (100 psi) maximum except by special agreement between user and manufacturer.

9. PRESSURE DROP

9.1 Open Center Pressure Drop (Inlet to Tank Port)

With control valve in the neutral position, vary the flow to the inlet port from zero to rated flow. See Figure 4.6. Test and record the pressure differential per SAE J1117.

9.2 Work Port Pressure Drop

9.2.1 Inlet to Work Port

Shift the control valve to direct flow from the inlet port to work port "A". Vary the input flow from zero to rated flow. Test and record the pressure differential per SAE J1117. Repeat for work port "B". (see Figure 4.1)

9.2.2 Work Port to Tank Port

Shift the control valve to direct flow from work port "B" to the tank port. Vary the input flow from zero to twice the rated flow. Test and record the pressure differential per SAE J1117. Repeat for work port "A". (see Figure 4.4)

9.3 Special Function Pressure Drop

Valves having a float, regenerative, etc. position shall not require test for pressure differential in this position, except by agreement between user and manufacturer.

¹ Other control inputs - use appropriate units